PIPING

Correct piping is critical to long-term operation of any fuel oil system. Improper line sizing will not only cause present and future service problems, but can also cause premature failure of the components supplied by it.

SINGLE-PIPE OR ONE-LINE SYSTEM

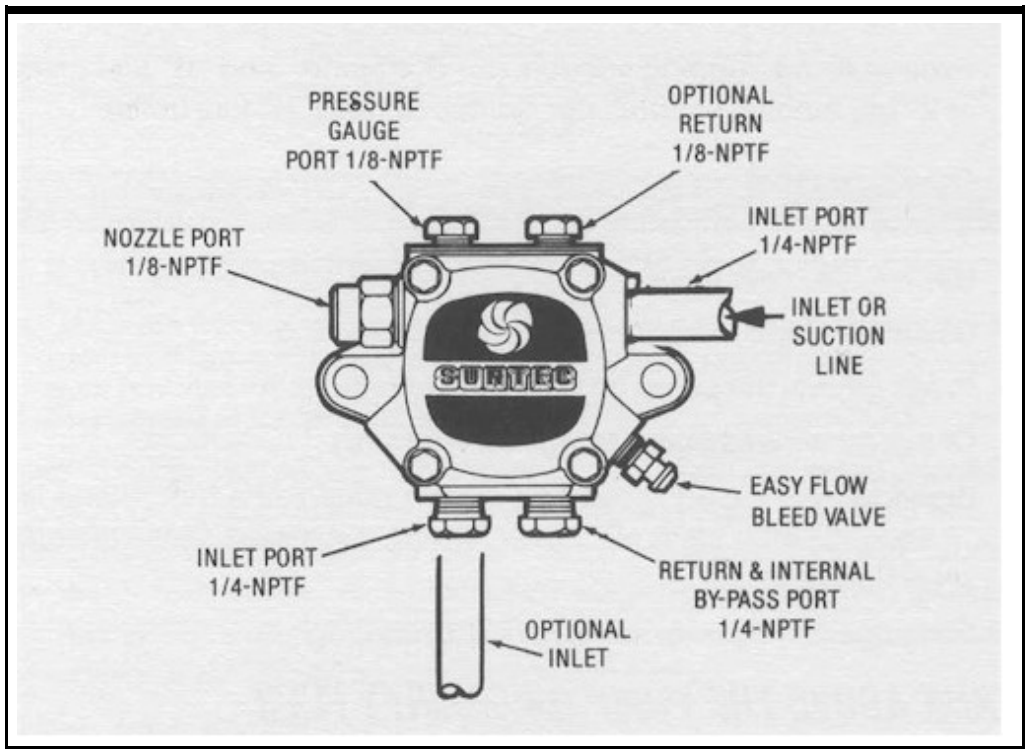


FIGURE 1

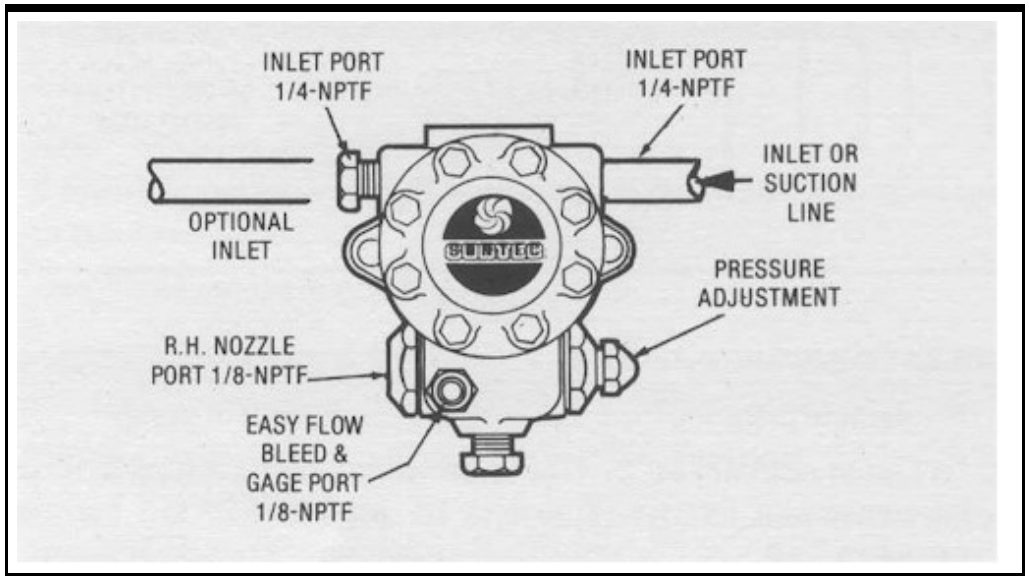


FIGURE 2

DO NOT

- Install by-pass plug. (Will damage seal.)
- Use compression fittings. (Will eventually leak.)
- Use teflon tape. (Will void warranty.)
- Use check valves. (Especially on gravity feed systems.) See Thermal Expansion, page III-12.
- Exceed 10 psi (manufacturer) or 3 psi (NFPA) inlet line pressure.
- Exceed 6" hg. running vacuum (for Suntec "A" and "B" fuel units) or 2" hg. running vacuum (for Suntec "J" and "H" fuel units.)

DO

- Use 37° JIC flare fittings.
- Use a non-hardening thread sealing compound.
- Prefill (prime) the pump on long runs to reduce dry running time.
- Check all unused pump fittings for tightness.
- Bleed system. Open bleed port approximately one turn. Bleed for 15 seconds after clear oil begins flowing out of port. Close bleeder valve tightly.
- See page IV-1 if pump fails to prime or deliver.

TANK ABOVE THE PUMP OR GRAVITY FEED

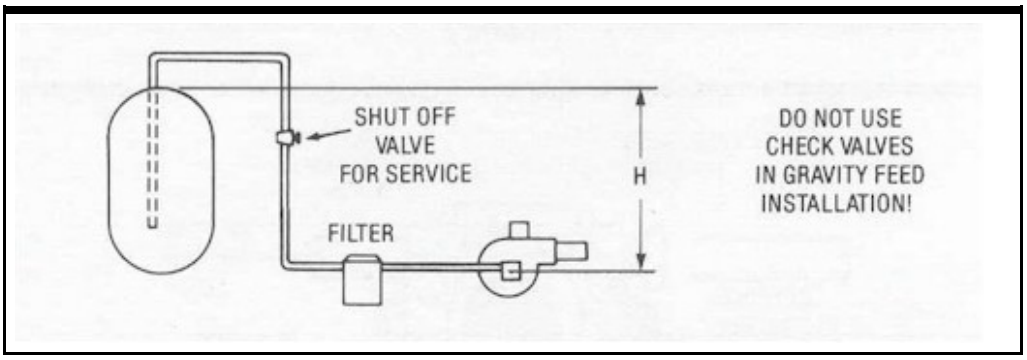


FIGURE 3

NOTES FOR FIGURE 3

1. H = vertical distance from top of tank to centerline of pump.
2. "H" must not exceed 27 feet to be within manufacturer's 10 psi inlet pressure limit, or 8 feet to be within NFPA's 3 psi inlet pressure limit.
3. See page II-3 for line sizing.

TANK BELOW THE PUMP OR LIFT FEED

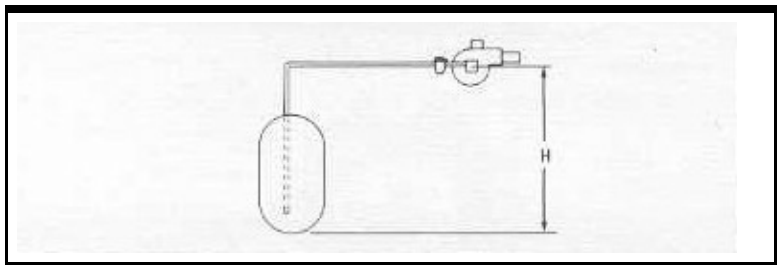


FIGURE 4

NOTES FOR FIGURE 4

1. H = vertical distance from bottom of tank to centerline of pump.
2. "H" must not exceed 8 feet for Suntec Model A and Model B fuel units or 2 feet for Suntec Model J and Model H fuel units.
3. See page II-3 for line sizing.

Even though pumps are capable of higher vacuums, good practice dictates that initial installation of Model A and B pumps and J and H pumps with a "F" piston do not exceed 6 inches of mercury vacuum on initial installation when installed single-pipe. J and H pumps without an "F" piston should not exceed 2 inches of mercury vacuum on initial installation when installed single-pipe.

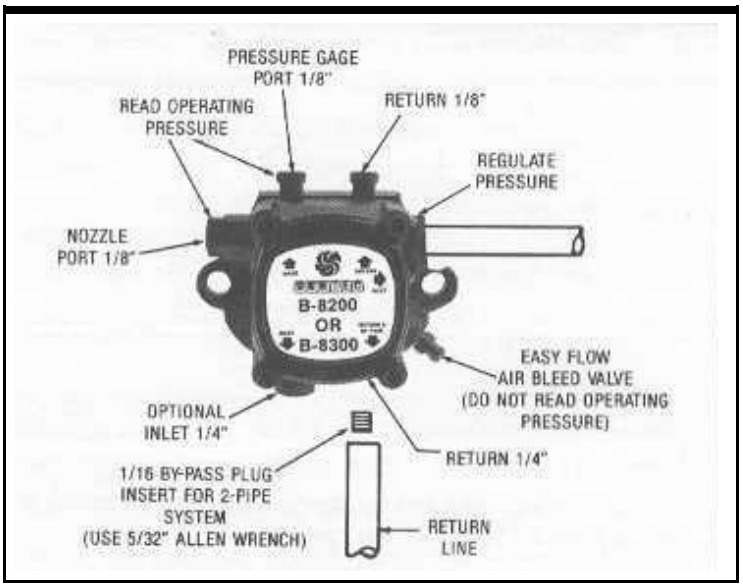
TWO-PIPE OR TWO-LINE SYSTEM

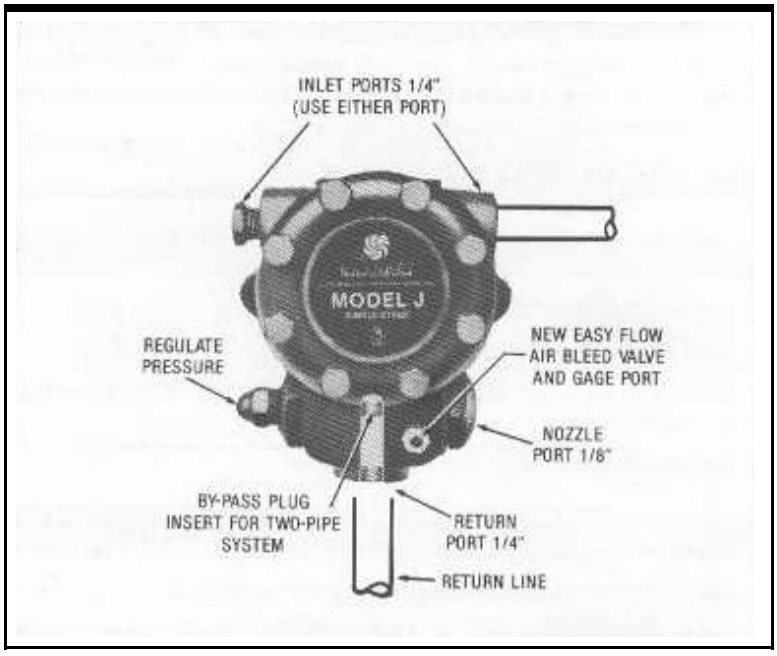
DO NOT

- Use compression fittings. (Will eventually leak.)
- Use teflon tape. (Will void warranty.)
- Exceed 10 psi (manufacturer) or 3 psi (NFPA) inlet and return line pressures.
- Use check valves in gravity feed systems.

DO

- Connect inlet or suction line to the fuel unit inlet port.
- Install the by-pass plug as shown. Failure to do so will caus improper fuel unit operation.
- Connect the return line to the fuel unit return port.
- Use 37° JIC flare fittings.
- Use a non-hardening thread sealing compound.
- Prefill (prime) the pump on long runs to reduce dry running time.
- Start fuel unit without bleeding (a properly-installed two-line system is self-priming).
- See page IV-1 if pump fails to prime or deliver.


PRESSURE GAGE PORT 1/8"
READ OPERATING PRESSURE
RETURN 1/8"
REGULATE PRESSURE
NOZZLE PORT 1/8"
B-8200
OR
B-8300
EASY FLOW AIR BLEED VALVE (DO NOT READ OPERATING PRESSURE)
OPTIONAL INLET 1/4"
RETURN 1/4"
1/16 BY-PASS PLUG INSERT FOR 2-PIPE SYSTEM (USE 5/32" ALLEN WRENCH)
RETURN LINE


INLET PORTS 1/4" (USE EITHER PORT)
MODEL J
REGULATE PRESSURE
NEW EASY FLOW AIR BLEED VALVE AND GAGE PORT
NOZZLE PORT 1/8"
BY-PASS PLUG INSERT FOR TWO-PIPE SYSTEM
RETURN PORT 1/4"
RETURN LINE

NOTE

A two-pipe or two-line system has three lines connected to the fuel pump. They are the inlet or suction line, return line, and nozzle line.

TANK ABOVE THE PUMP OR GRAVITY FEED

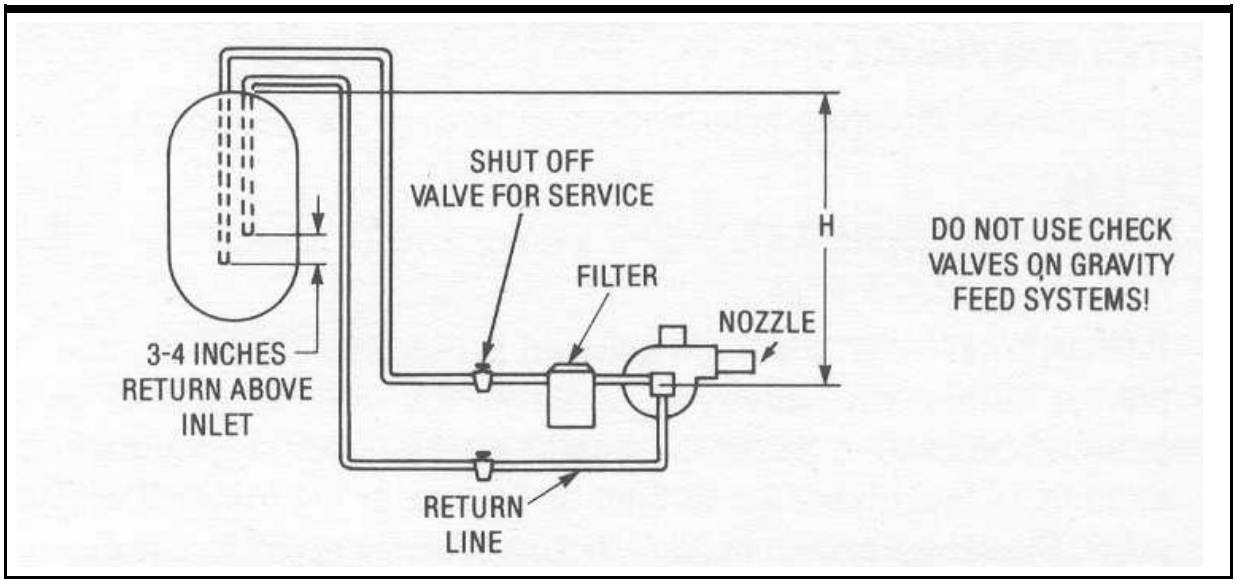


FIGURE 7

NOTES FOR FIGURE 7

1. H = vertical distance from top of tank to centerline of pump.
2. "H" must not exceed 27 feet to be within manufacturer's 10 psi inlet pressure limit, or 8 feet to be within NFPA's 3 psi inlet pressure limit.
3. See page III-7 for line sizing.
4. **IMPORTANT** - Single-pipe installation is recommended for gravity feed systems. It produces lower inlet line flow and longer filter life. For example: an "A-70" fuel unit firing 1 gph single-pipe has 1 gph flowing through the filter; an "A-70" pump firing 1 gph two-pipe has 19 gph flowing through the filter.

TANK BELOW THE PUMP OR LIFT FEED

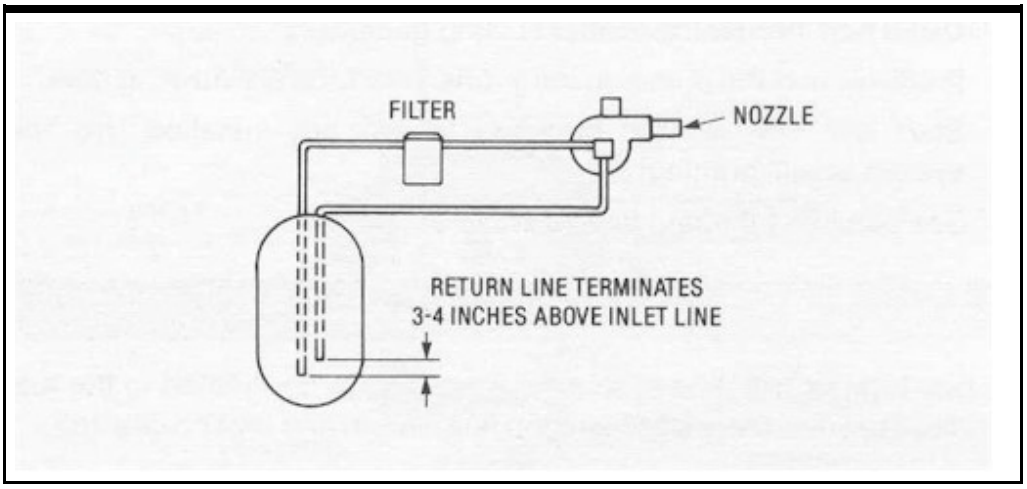


FIGURE 8

NOTES FOR FIGURE 8

1. H = vertical distance from bottom of tank to the centerline of the pump.
2. “H” must not exceed 12 feet for single-stage fuel units, or 18 feet for two-stage fuel units.
3. **IMPORTANT** - “H” distance allowed is reduced by the number of fittings, filters, and valves installed in the line. If the fuel lines extend higher than the centerline of the fuel unit, they should not exceed 24 feet above the bottom of the tank or the fuel unit will not prime (boost pump would be required). See page II-23.
4. System running vacuum should not exceed 12 in. hg. for single-stage fuel units or 17 in. hg. for two-stage fuel units.
5. **IMPORTANT** - Vacuum requirements are not limited by fuel unit capability. Fuel oil will boil or de-gas at vacuums as low as 10 in. hg. These bubbles can get into the nozzle line and cause a smoky or unstable flame. Suntec two-stage pumps are designed to prevent this with vacuums up to 17 in. hg.
6. See page III-7 for line sizing.

LINE SIZING · TWO-PIPE SYSTEMS

NEW INSTALLATIONS FOR NEW LINES

NOTE: The formulas in this section are set up to keep new installations within practical design limits for fuel pumps. Viscosity used for calculations is 57 saybolt secs. universal = 8.04 centipoise = 9.6 centistokes. Calculated lengths do not include valves, filters and an unusual number of 90° elbows.

Installations should avoid putting fuel oil where it is exposed to temperature extremes. The pour point limit for #1 and #2 fuel oils not seasonally-adjusted is 0°F and 20°F, respectively.

GEARSET/INLET LINE FLOW • GALLONS PER HOUR																	
Suntec Model No.	**A 7*** 3 GPH**	**A 7*** 7 GPH**	**B 82** 3 GPH**	**B 89** 3 GPH**	**B 89** 7 GPH**	**B 8850**	**B 8852**	**J2 J3**	**J4**	**J5**	**J6**	**H2 H3**	**H4**	**H5**	**H6**	**H7**	**H8**
Flow at 1725 rpm	16	-	18	-	-	-	-	18	22	29	38	26	31	36	42	69	98
Flow at 3450 rpm	17	20	21	25	28	33	39	38	46	60	78	61	69	79	93	-	-

LENGTH OF RUN (L)

The length of piping from tank to fuel unit is calculated using the following formulae which are based on flow properties for a given tubing size.

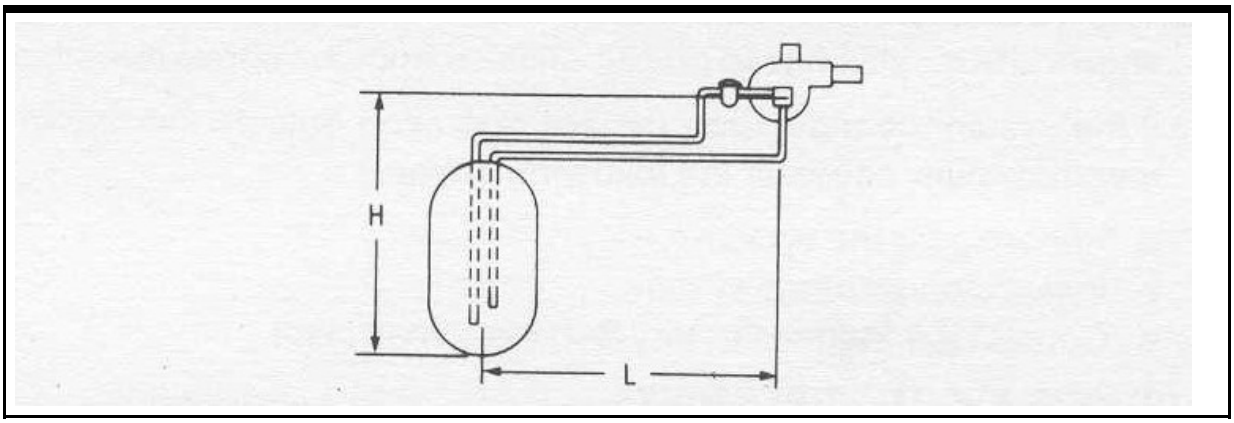


FIGURE 9

L - Horizontal run in feet from tank to fuel unit.
H = Vertical distance in feet from bottom of tank to centerline of pump.
Q = Gearset (or line) flow in gallons per hour (gph).
V = Vacuum in inches of mercury (in. hg.).

EXISTING INSTALLATIONS

The following formulae can be used to determine what the vacuum should be on

various line lengths of different size line tubing. The resulting figures may be used to determine if the configuration of an existing installation could cause system performance problems.

Tube Size O.D. (inches) (.035" wall)	Tank Below Pump		Tank Above Pump	
	Single-Stage	Two-Stage	Single-Stage	Two-Stage
3/8	$L = \frac{12-(.75H)}{.0086Q}$	$L = \frac{17-(.75H)}{.0086Q}$	$L = \frac{12+(.75H)}{.0086Q}$	$L = \frac{17+(.75H)}{.0086Q}$
1/2	$L = \frac{12-(.75H)}{.00218Q}$	$L = \frac{17-(.75H)}{.00218Q}$	$L = \frac{12+(.75H)}{.00218Q}$	$L = \frac{17+(.75H)}{.00218Q}$
5/8	$L = \frac{12-(.75H)}{.000785Q}$	$L = \frac{17-(.75H)}{.000785Q}$	$L = \frac{12+(.75H)}{.000785Q}$	$L = \frac{17+(.75H)}{.000785Q}$

Tube Size O.D. (inches) (.035" wall)	Vacuum*	
	Tank Below Pump	Tank Above Pump
3/8	V = L (.0086Q) + .75H	V = L (.0086Q) - .75H
1/2	V = L (.00218Q) + .75H	V = L (.00218Q) - .75H
5/8	V = L (.00785Q) + .75H	V = L (.000785Q) - .75H

*Does not include valves, filters, etc., in the line.

NOTES

1. Kinks or sharp bends in lines will increase vacuuum.
2. Return line pressure should not exceed 10 psi (manufacturer) or 3 psi (NFPA).
3. The installation instructions supplied with each Suntec fuel unit shows line lengths based on calculations from the above formulae.
4. If the system configuration causes operation outside the recommended limits, consider the following options:
   a. Reconfigure the system.
   b. Install a boost pump system.
   c. Contact the Suntec Factory Service Department.

ADD-ONS AND MULTIPLE UNITS

When adding or installing new fuel units to an existing system, good practice is to have separate lines for each system. If running separate lines is difficult, impractical and/or impossible, it may be necessary to tie a new system into an old one.

Before tying into an existing system, consider:

1. What the running vacuum of the present system is. (See Vacuum Testing, page IV-9.)
2. What the extra distance will be to the new fuel unit.

If a new identical fuel unit will be installed side-by-side with the existing unit, its addition will **at least** double the vacuum with both units running.

Line Sizing. Lines should be sized to have a **small enough** inside diameter to allow complete purging of air during priming or bleeding, and **large enough** to not cause excessive pressure drop or line losses which would cause the pump to operate with too high a vacuum.

Priority Controls. Relays which give operating preference to a specific unit, can be used to assure that only one fuel unit is operating at a time. For example, priority is usually given to a hot water heater rather than a furnace or boiler.

INSTALLING PRIORITY CONTROLS

Two options exist:

1. Less than ideal: Priority controls controlled by low voltage from the thermostat. Disadvantage: If the primary unit locks out on “safety,” the secondary system cannot automatically operate.
2. Preferred: Use a power relay to establish priority based on line voltage demand. Advantage: Allows the line voltage to be available to the secondary unit if a fault occurs in the primary unit. (Should be installed by a qualified electrician.)

SERVICING NON-RECOMMENDED EXISTING INSTALLATIONS

Occasionally, you will find existing installations which do not conform to good practice or proper installation. The correct procedure is to replace these piping configurations with correct piping. However, in the real world, this is sometimes impractical or financially impossible. The following information will help you identify and work with these types when you encounter them in the field.

MULTIPLE UNITS WITH UNDERSIZE OR OVERSIZE INLET MANIFOLDS • SINGLE-PIPE (TANK ABOVE OR BELOW FUEL UNITS)

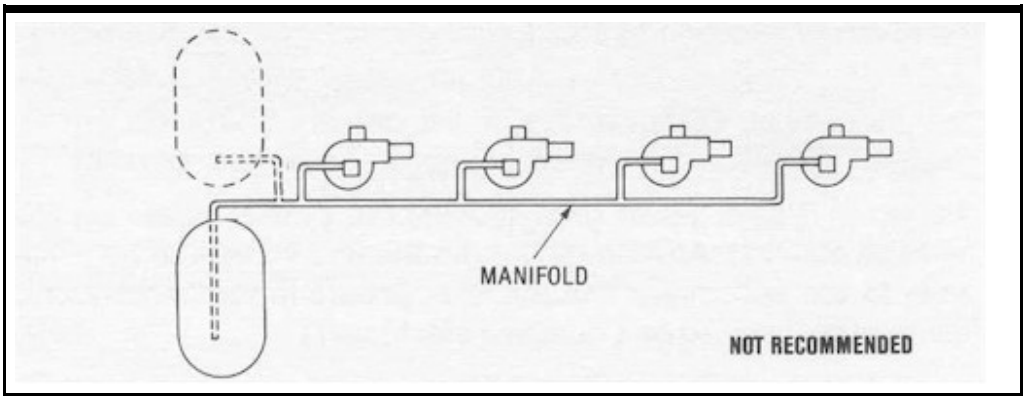


FIGURE 10

Line Sizing. The manifold or supply line must be sized to accommodate the total **firing rate** of all units connected to the manifold (A + B + C + D as shown above). See Installation Section for specific model, for single-line calculation formula.

Priming. Bleed or prime units beginning with the unit closest to the tank and working outward. Since priming this type of system would require extended operation of the fuel units with dry gear sets, the fuel unit should be filled with oil before beginning.

Recommendation. This type of system should be supplemented with a boost pump system to provide the proper oil supply to the fuel units. See Boost Pumps or Transfer Pumps, page II-23.

TWO-PIPE • *(TANK ABOVE OR BELOW FUEL UNITS)*

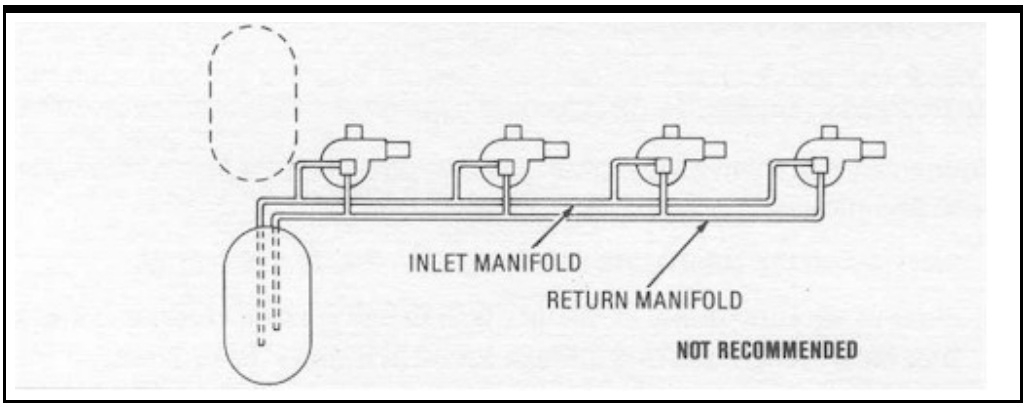


FIGURE 11

Line Sizing. The manifolds or supply lines must be sized to accommodate the total **gear set capacity** (not firing rate) or all units connected to the manifold (A + B + C + D, as shown above). See Line Sizing, page III-7, for fuel unit gear set capacities. If lines are undersized, they must be replaced, or use priority controls.

Return line manifold piping and input manifold piping must be the same size.

Priming. Return line must terminate below the surface of the oil in the tank to maintain prime.

Start or prime units beginning with the unit closest to the tank and working outward. Since priming this type of system would require extended operation of the fuel units with dry gear sets, the fuel unit should be filled with oil before starting.

DRAWBACKS

a. Problems with one unit affects all units.
b. Line sizes are a compromise.
c. Troubleshooting is more complicated.
d. Making and keeping system air-free is time-consuming.

RECOMMENDATIONS

a. Install individual lines to multiple units, or
b. Incorporate a boost pump system to supply adequate fuel to the multiple units. See Boost Pumps or Transfer Pumps, page II-23.

CHECK VALVES, OTHER VALVES AND THERMAL EXPANSION

Check Valves. A properly-installed fuel oil heating system does not require check valves for proper operation.

However, check valves are often used to compensate for deficiencies in oil line piping. For example:

a. Not having the return line submerged in the oil in the tank

b. Having vacuum leaks in the line due to using compression fittings, bad flare fittings, porous fittings, loose fittings or leaky lines.

Disadvantages:

Check valves increase the amount of vacuum the fuel unit must overcome to supply oil to the system and reduce the distance supply lines can be run.

When installed near the fuel unit, check valves cause turbulence and stripping of air from the oil, resulting in dirty and/or noisy combustion.

Do not use check valves in gravity feed (tank above pump) single-pipe systems, or in a system supplied by a boost or transfer pump. Thermal expansion can cause serious problems.

Thermal Expansion. Thermal expansion is a phenomenon in which a fluid increases in volume when heated.

When fuel oil is heated from 40°F to 70 °F, it will increase in volume by 1 - 1/2%. Since oil will only compress at a rate of 1/10%, thermal expansion will greatly increase the oil pressure in a closed system.

In a typical single-pipe system, an air pocket within the pump serves as a cushion against changes in pressure. In a gravity feed- or boost pump-supplied system, the air cushion is eventually absorbed, creating a hydraulically “hard” or closed system which is unable to absorb pressure increases.

EFFECTS OF THERMAL EXPANSION:

a. Leaks at pipe joints and fittings.
b. Broken pressure gages.
c. Leaks at filters.
d. Leaks at fuel unit seals.

CONDITIONS WHERE THERMAL EXPANSION CAN CAUSE PROBLEMS:

a. In single-pipe, dual-fuel systems (during alternate fuel operation).
b. Where ambient temperature around the supply line is higher than the fuel temperature (ceilings of industrial/commercial buildings, boiler rooms, mobile home enclosed furnace vestibules).

PREVENTION OF THERMAL EXPANSION PROBLEMS:

a. Install relief valves in problem areas (see Figure 14).
b. Do not use check valves.
c. Install an accumulator in the line.

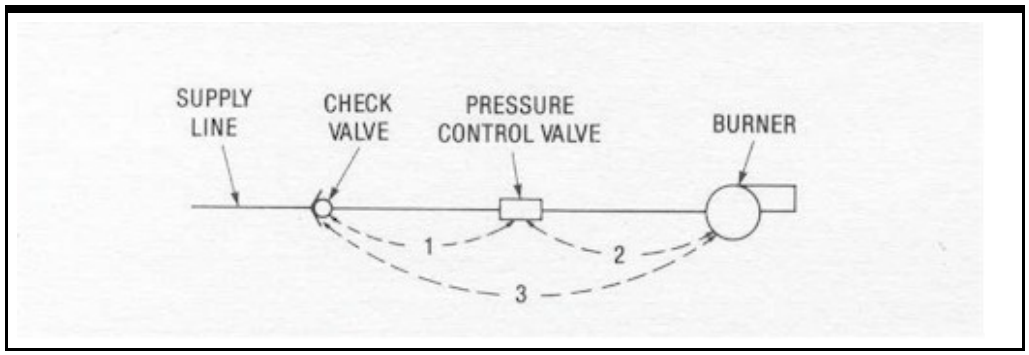


FIGURE 12 CLOSED OIL SYSTEMS

1. A closed system will occur between the check valve and the pressure control valve during burner off-cycle.
2. A closed system will occur between the pressure control valve and the burner pump, since the regulating valve in the pump is also a positive shut-off valve.
3. Since the regulating piston in the pump is also a positive shut-off valve, a closed system will occur during burner off-cycle even without the vacuum safety valve installed.

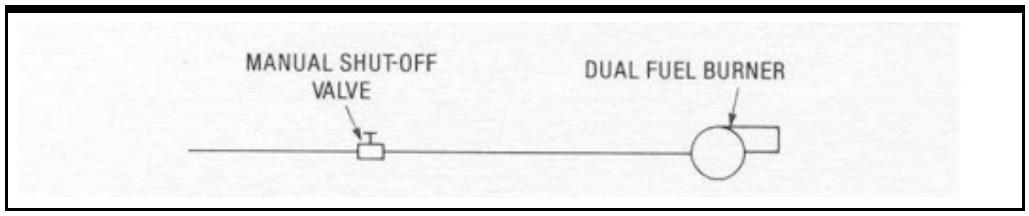


FIGURE 13 CLOSED OIL SYSTEM, DUAL-FUEL BURNER

1. A closed circuit will occur between the manual valve and the burner if the valve is closed during alternate fuel operation.

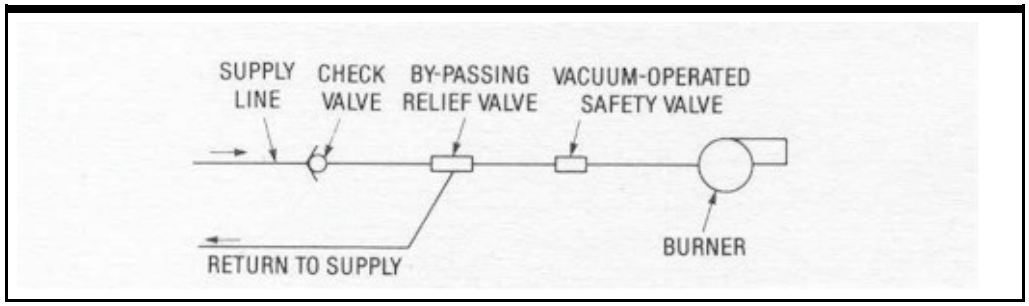


FIGURE 14 BY-PASSING RELIEF VALVE INSTALLATION

NOTE: All installations should be in compliance with local and national codes. Typical installation diagrams contained in this Technical Service Manual are for reference only.